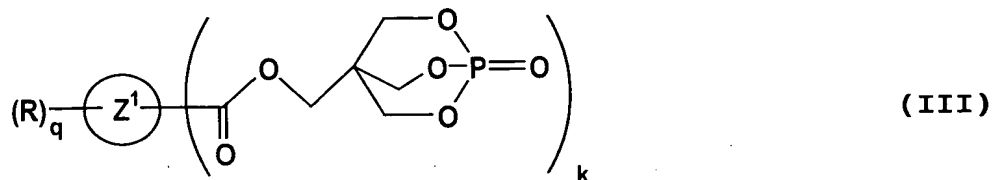
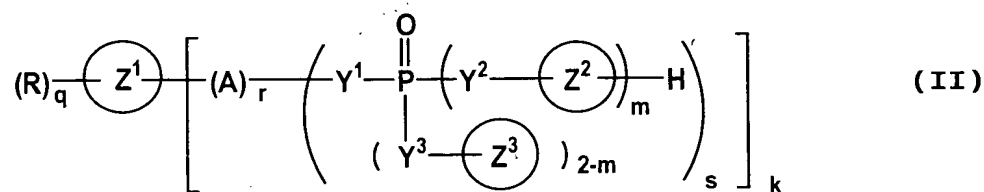
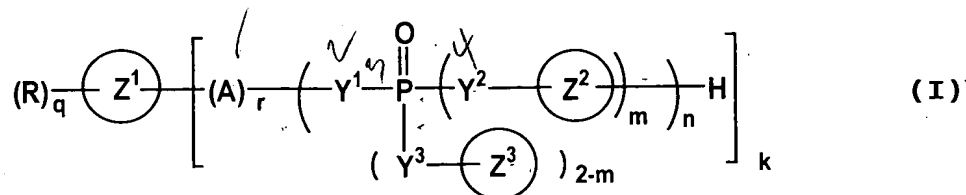


# CLAIMS

1. A phosphorus-containing compound represented by the following formula (I), (II) or (III):

5



wherein Z<sup>1</sup>, Z<sup>2</sup> and Z<sup>3</sup> are the same or different, each representing a cycloalkane ring, a cycloalkene ring, a polycyclic aliphatic hydrocarbon ring or an aromatic hydrocarbon ring, in which these rings may have a substituent; R represents a halogen atom, a hydroxyl group, a carboxyl group, a halocarboxyl group, an alkyl group, an alkoxy group, an alkenyl group or an aryl group; A represents a polyvalent group corresponding to an alkane;

10

$Y^1$ ,  $Y^2$  and  $Y^3$  are the same or different, each representing -O-, -S- or -NR<sup>1</sup>-

wherein R<sup>1</sup> represents a hydrogen atom or an alkyl group;

5 k represents an integer of 1 to 6; m represents an integer of 0 to 2; n represents an integer of not less than 1; q represents an integer of 0 to 5; r represents 0 or 1; s represents an integer of 1 to 4; and

provided that when Z<sup>1</sup> is a cyclohexane ring, q is 0, and k is 1, factor r for A is 1; when Z<sup>1</sup> is a cyclohexane ring, q is 0, and k is 2 to 6, at least one of plural factors r for A is 1; and when Z<sup>1</sup> is a benzene ring and k is 1, the factor r for A is 1; when Z<sup>1</sup> is a benzene ring and k is 2 to 6, at least one of plural factors r for A is 1.

15 2. A phosphorus-containing compound according to claim 1, wherein the rings Z<sup>1</sup>, Z<sup>2</sup> and Z<sup>3</sup> each is a dicyclic or tricyclic aliphatic hydrocarbon ring.

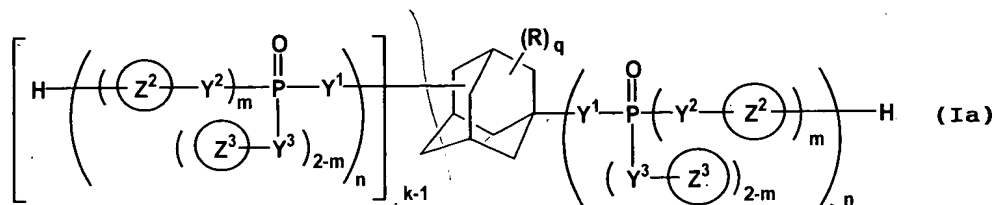
3. A phosphorus-containing compound according to claim 1, wherein the ring Z<sup>1</sup> is a norbornane ring, an adamantane ring, a tricyclo[5.2.1.0<sup>2,6</sup>]decane ring, or a benzene ring, and the rings Z<sup>2</sup> and Z<sup>3</sup> each is an adamantane ring or a benzene ring.

4. A phosphorus-containing compound according to claim 1, wherein R is a halogen atom, a hydroxyl group, a C<sub>1-4</sub>alkyl group, or a C<sub>1-4</sub>alkoxy group in the formula (I).

25 5. A phosphorus-containing compound according to claim 1, wherein each Y<sup>1</sup>, Y<sup>2</sup> and Y<sup>3</sup> represents -O-.

6. A phosphorus-containing compound according to claim 1, wherein k is an integer of 1 or 2, n is 1, and q is an integer of 0 to 2.

7. A phosphorus-containing compound according to claim 1, wherein a phosphorus-containing compound of the formula (I) is represented by the following formula (Ia):



wherein the Z<sup>2</sup>, Z<sup>3</sup>, R, Y<sup>1</sup>, Y<sup>2</sup>, Y<sup>3</sup>, k, m, n and q have the same meanings as defined above.

8. A phosphorus-containing compound according to claim 7, wherein, in the formula (Ia), Z<sup>2</sup> and Z<sup>3</sup> are the same or different, each representing a benzene ring or an adamantane ring in which these rings may have a substituent; R is a halogen atom, a hydroxyl group, a C<sub>1-6</sub>alkyl group, or a C<sub>1-6</sub>alkoxy group; Y<sup>1</sup>, Y<sup>2</sup> and Y<sup>3</sup> each is -O- or -NR<sup>1</sup>- (wherein R<sup>1</sup> represents a hydrogen atom or a C<sub>1-4</sub>alkyl group)); k is an integer of 2 to 4; n is an integer of 1 to 3; and q is an integer of 0 to 4.

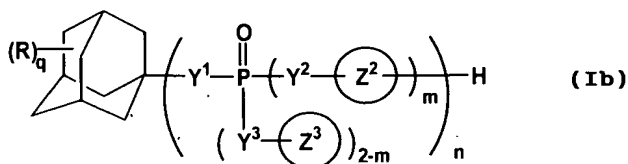
9. A phosphorus-containing compound according to claim 7, wherein, in the formula (Ia), Z<sup>2</sup> and Z<sup>3</sup> are the same or different, each representing a benzene ring which may have a substituent; R is a C<sub>1-4</sub>alkyl group; n is 1; and

q is an integer of 0 to 2.

10. A phosphorus-containing compound according to claim 7, wherein a compound represented by the formula (Ia) is an adamantylbis, tris or tetrakis-(diC<sub>6-10</sub>aryl phosphate) or an adamantylbis, tris or tetrakis(diC<sub>6-10</sub>aryl phosphoramidate).

11. A phosphorus-containing compound according to claim 7, wherein a compound represented by the formula (Ia) is adamantylbis(diphenylphosphate), dimethyladamantyl bis(diphenylphosphate), or adamantyltris(diphenyl phosphate).

12. A phosphorus-containing compound according to claim 1, wherein a compound of the formula (I) is represented by the following formula (Ib):



wherein the Z<sup>2</sup>, Z<sup>3</sup>, R, Y<sup>1</sup>, Y<sup>2</sup>, Y<sup>3</sup>, m, n and q have the same meanings as defined above.

13. A phosphorus-containing compound according to claim 12, wherein, in the formula (Ib), Z<sup>2</sup> and Z<sup>3</sup> are the same or different, each representing a benzene ring or an adamantane ring in which these rings may have a substituent; R is a halogen atom, a hydroxyl group, a C<sub>1-6</sub>alkyl group, or a C<sub>1-6</sub>alkoxy group; Y<sup>1</sup>, Y<sup>2</sup> and Y<sup>3</sup> are the same or different,

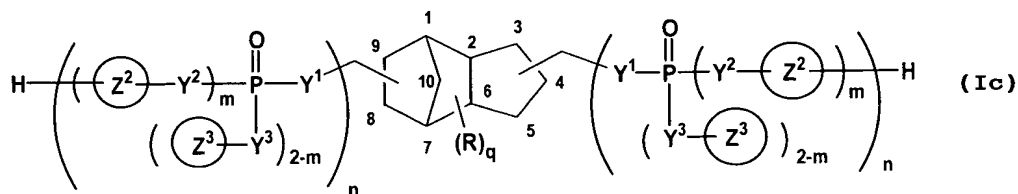
each representing -O- or -NR<sup>1</sup>- wherein R<sup>1</sup> represents a hydrogen atom or a C<sub>1-4</sub>alkyl group; and q is an integer of 0 to 4.

14. A phosphorus-containing compound according to claim 12, wherein, in the formula (Ib), R is a hydroxyl group, a C<sub>1-4</sub>alkyl group, or a C<sub>1-4</sub>alkoxy group, and q is an integer of 0 to 2.

15. A phosphorus-containing compound according to claim 12, wherein a compound represented by the formula (Ib) is an adamantyldiC<sub>6-10</sub>arylphosphate or a diadamantyl C<sub>6-10</sub>arylphosphate.

16. A phosphorus-containing compound according to claim 12, wherein a compound represented by the formula (Ib) is adamantyldiphenylphosphate, dimethyladamantyl diphenylphosphate, or bis(adamantyl)phenylphosphate.

17. A phosphorus-containing compound according to claim 1, wherein a compound of the formula (I) is represented by the following formula (Ic):



20

wherein the Z<sup>2</sup>, Z<sup>3</sup>, Y<sup>1</sup>, Y<sup>2</sup>, Y<sup>3</sup>, m, n and q have the same meanings as defined above.

18. A phosphorus-containing compound according to

claim 17, wherein, in the formula (Ic),  $Z^2$  and  $Z^3$  each is a benzene ring which may have a substituent; R is a halogen atom, a hydroxyl group, a  $C_{1-6}$ alkyl group, or a  $C_{1-6}$ alkoxy group; and  $Y^1$ ,  $Y^2$  and  $Y^3$  are -O-.

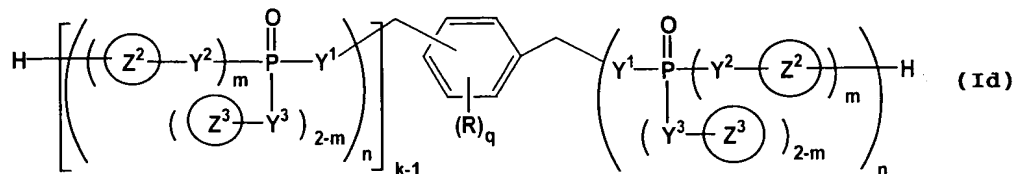
5           19. A phosphorus-containing compound according to claim 17, wherein a compound represented by the formula (Ic) is bis[(di $C_{6-10}$ arylphosphoroxy)methyl]tricyclo[5.2.1.0<sup>2,6</sup>]decane.

10           20. A phosphorus-containing compound according to claim 17, wherein a compound represented by the formula (Ic) is bis[(diphenylphosphoroxy)methyl]tricyclo[5.2.1.0<sup>2,6</sup>]decane.

15           21. A phosphorus-containing compound according to claim 17, wherein a compound represented by the formula (Ic) is (4R,8S)-bis(diphenylphosphoroxymethyl)-(1R,2S,6R,7R)-tricyclo[5.2.1.0<sup>2,6</sup>]decane.

22. A phosphorus-containing compound according to claim 1, wherein a compound of the formula (I) is represented by the following formula (Id):

20



wherein the  $Z^2$ ,  $Z^3$ , R,  $Y^1$ ,  $Y^2$ ,  $Y^3$ , m, n and q have the same meanings as defined above.

23. A phosphorus-containing compound according to



a halogen atom, a hydroxyl group, a C<sub>1-6</sub>alkyl group which may have a substituent, a C<sub>1-6</sub>alkoxy group which may have a substituent, or an alkenyl group which may have a substituent; and Y<sup>1</sup>, Y<sup>2</sup> and Y<sup>3</sup> are -O-.

5           27. A phosphorus-containing compound according to claim 25, wherein, in the formula (Ie), n is 1; q is an integer of 0 to 2; r is 1; and s is an integer of 1 to 2.

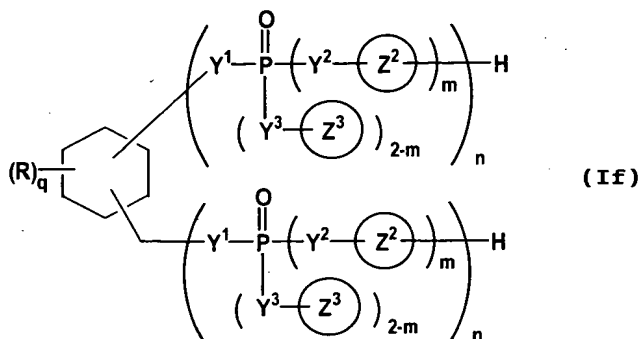
28. A phosphorus-containing compound according to claim 25, wherein a compound represented by the formula  
10 (Ie) or (IIa) is bis(diphenylphosphoroxynorbornane;  
bis(diphenylphosphoroxyc<sub>1-4</sub>alkyl)norbornane;  
bis(diphenylphosphoroxyc<sub>1-4</sub>alkyl)cyclohexane;  
(diphenylphosphoroxyc<sub>1-4</sub>alkyl)cyclohexene; mono, di or  
tri-C<sub>1-4</sub>alkyl(diphenylphosphoroxyc<sub>1-4</sub>alkyl)cyclohexyl  
15 phosphate; or bis(diphenylphosphoroxyc<sub>1-4</sub>alkyl)cyclohexane.

29. A phosphorus-containing compound according to claim 25, wherein a compound represented by the formula (Ie) or (IIa) is 2,3-bis(diphenylphosphoroxynorbornane,  
20 2,5-bis(diphenylphosphoroxymethyl)norbornane, 1,2-bis(diphenylphosphoroxyc<sub>1-4</sub>alkyl)cyclohexane, 1-diphenylphosphoroxymethyl-3-cyclohexene, 3,3,-dimethyl-5-(diphenylphosphoroxymethyl)cyclohexyl phosphate, or  
1,2-bis(diphenylphosphoroxyc<sub>1-4</sub>alkyl)cyclohexane.  
25

30. A phosphorus-containing compound according to claim 25, wherein a compound of the formula (Ie) is



represented by the following formula (If):

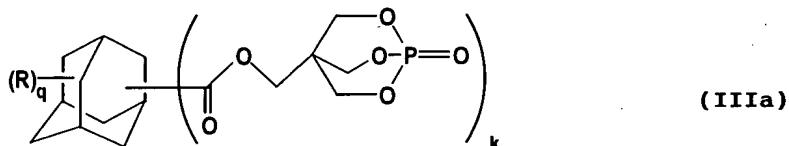


wherein  $Z^2$ ,  $Z^3$ , R,  $Y^1$ ,  $Y^2$ ,  $Y^3$ , m, n and q have the  
 5 same meanings as defined above.

31. A phosphorus-containing compound according to  
claim 30, wherein, in the formula (If),  $Z^2$  and  $Z^3$  are the  
 same or different, each representing a benzene ring; R is  
 a halogen atom, a hydroxyl group, a  $C_{1-6}$ alkyl group, or a  
 10  $C_{1-6}$ alkoxy group; and  $Y^1$ ,  $Y^2$  and  $Y^3$  are the same or different,  
 each representing -O- or -NR<sup>1</sup>-.

32. A phosphorus-containing compound according to  
claim 30, wherein a compound represented by the formula  
 (If) is 1-diphenylphosphoroxo-3-diphenylphosphoroxo  
 15 methylcyclohexane or 3,3,-dimethyl-5-(diphenyl  
 phosphoroxymethyl)cyclohexylphosphate.

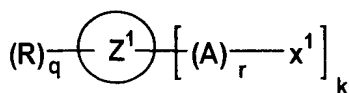
33. A phosphorus-containing compound according to  
claim 1, wherein a compound of the formula (III) is  
 represented by the following formula (IIIa):



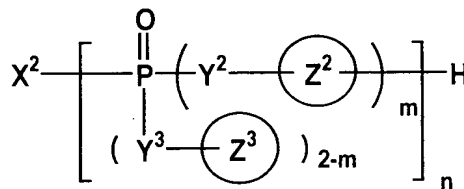
wherein R, q and k have the same meanings as defined above.

34. A phosphorus-containing compound according to claim 33, wherein, in the formula (IIIa), R is a carboxyl group, a halocarboxyl group, or a C<sub>1-4</sub>alkyl group.

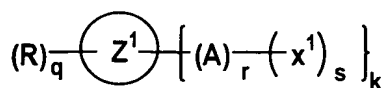
35. A process for producing a phosphorus-containing compound represented by the formula (I), (II) or (III) recited in claim 1, which comprises reacting a compound represented by the following formula (I-1), (II-1) or (III-1) with a compound represented by the following formula (I-2), (II-2) or (III-2):



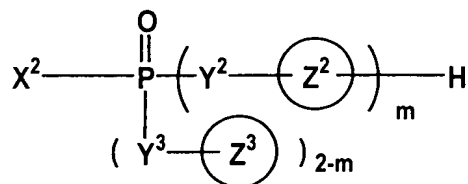
(I-1)



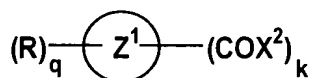
(I-2)



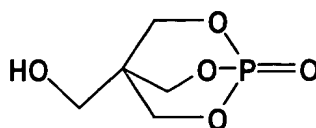
(II-1)



(II-2)



(III-1)



(III-2)

wherein  $X^1$  represents a hydroxyl group, a thiol group,  
 an amino group, or a substituted amino group;  $X^2$  represents  
 a halogen atom, a hydroxyl group, or an alkoxy group; and  
 the  $Z^1$ ,  $Z^2$ ,  $R$ ,  $Y^1$ ,  $Y^2$ ,  $Y^3$ ,  $k$ ,  $m$ ,  $q$ ,  $r$  and  $s$  have the same  
 meanings as defined above.